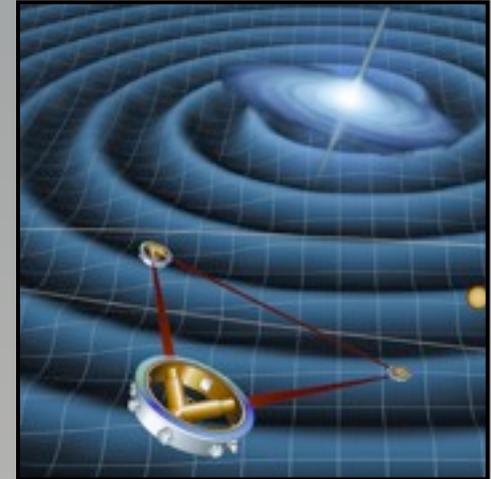
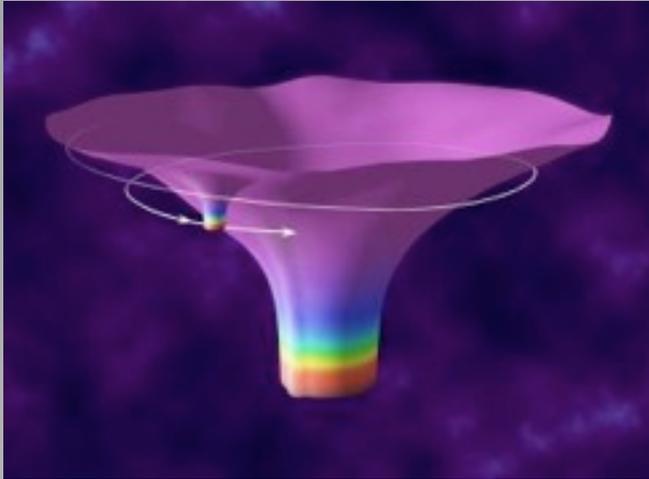


Gravitational Wave Science Analysis Group GW-SAG



**Inaugural meeting
Washington, DC
August 14-15, 2012**

- Organization and roles of GW-SAG
- Potential future Opportunities
- Technology Development Plan for next few years
 - Different scenarios
 - ST 7/LISA Pathfinder
- Science and Data Analysis
- Advocacy

GW-SAG within PhysPAG/PCOS/NASA

The goal of the Gravitational Wave Science Analysis Group (GWSAG) is to provide quantitative metrics and assessments to NASA in regard to a future Gravitational Wave mission. Specifically, the GWSAG will

- **Track and analyze evolving science goals and requirements**, especially as our understanding of three standard sources of gravitational waves (SMBH, EMRI, GB) continues to improve.
- **Support mission studies and concept development** for future space-based gravitational wave observatories, including where cost savings are sought and/or new classes of sources are to be considered (e.g., stochastic GW background from the Big Bang).
- **Analyze technology development and prioritization plans** with respect to redefined science goals and the evolution of mission concepts (i.e., the GWSAG will aid the PhysPAG in analyzing technology needs).
- **Advocate for gravitational wave astrophysics and astronomy** and explain the importance of this new field to the wider scientific community and also to the public.

The GWSAG is open to all members of the community ... and has a mailing list

Subscribe at: GWSAG-subscribe@lists.nasa.gov 

GW SAG

- GW-SAG

1. US Counterpart of the scientific part of the European Consortium
2. Replaces to some degree US part of LIST
3. Provides community input and outside expertise for Technology development plans
4. Advocacy

- Open group with no funding ...

- Have to depend on telecons, wikis, and occasional meetings at larger conferences
- Funding is an issue, especially when we talk about real deliverables
- But we have to get started ...

How do we organize the GW-SAG?

Currently have two weekly telecons in US:

1. Former project telecon incl. some of our former European partners
2. US Core Team to discuss technology (US only)

- GW SAG members can join them
 - to stay up to date on current developments and future events
- Organize additional telecons/web meetings as needed
- PCOS office organized mailing list
- We will establish web presence (wiki?)

How do we organize GW-SAG?

We will form three open task forces

- Science (Lead: Neil Cornish)
- Technology (Lead: Guido Mueller for now)
- Advocacy (Lead: Scott Hughes)

Leads will activate/organize task forces for specific tasks

Examples:

- Calculate detection rates and parameter for new mission design
(Science group)
- Develop technology plan, prioritize technologies, evaluate new ideas
(in conjunction with Core Team at NASA)
- Organize/Coordinate activities at meetings (Advocacy)

Future mission opportunities

- Junior Partner on eLISA
 - Decision in Europe 2013/14 (Best guesses)
 - Pathfinder data in by 2015/16
 - Commitment from NASA required by 2016/17
 - Phase A - level Funding (L2) earliest 2017/18 (Launch 2027/28)
 - Depends on level of involvement
- Next large mission opportunity
 - Selection 2015
 - Phase A - level 2017/18 Launch (2025/26)
- Win the next Decadal
 - Selection 2020/21
 - Phase A 202?

Future mission opportunities

- Junior Partner on eLISA
 - Decision in Europe 2013/14 (Best guesses)

- Pathfinder 1 mission 2015/16

- Con

- Pha

-

- Next lar

- Sele

- Pha

- Win the next Decadal

- Selection 2020/21

- Phase A 202?

What are the priorities
for technology development
for these three cases?

What is common?

How are they different?

Future mission opportunities

- Junior Partner on eLISA
 - Decision in Europe 2013/14 (Best guesses)

- Path 2015/16

- Con

- Pha

-

- Next lar

- Sele

- Pha

- Win the next Decadal

- Selection 2020/21

- Phase A 202?

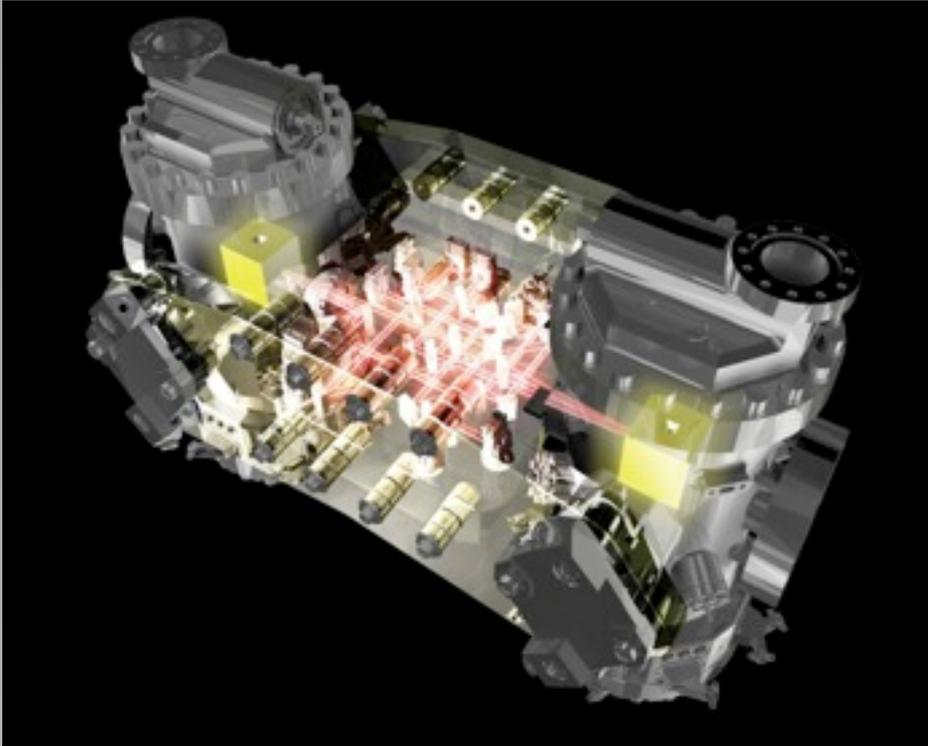
What are the priorities

The following is work in progress

Plan to discuss with
Core Team over next weeks

How are they different?

LISA Pathfinder



Expected Launch: 2014
Includes ST 7 (US part)



ST7 & LTP

- Goal is to test the Gravitational Reference Sensor
 - Create two free falling proof masses inside spacecraft
 - Disturbance Reduction System (DRS)
 - Measure the residual acceleration of two Proof masses
 - with respect to each other
 - with respect to the spacecraft
 - Steer the spacecraft around the proof masses
 - Actuate on the proof masses to follow the spacecraft

LISA with a short (30cm) arm

Demonstrates many of the critical technologies required for LISA!

US contribution (ST 7): Thrusters and control laws

ST7 & LTP

- Opportunities for data analysis exist
 - Requests from Europe to participate in Data Analysis effort
 - Goal: Understand GRS, DRS and DA issues w. GRS
- ST 7 planning during ST 7 part of science mode
 - Still options to discuss certain modes of operation
 - Include IFO, Drift mode
- A much larger participation in ST7/Pathfinder of NASA and the US community is essential to take full advantage of past investments

We are in danger of missing out on this opportunity!

Take advantage of the money we already spent!

Ideally: Directed funding plus maybe some competed funding

ST7 & LTP

- Opportunities for data analysis exist
 - Requests from Europe to participate in Data Analysis effort
 - Goal: Understand GRS, DRS and DA issues w. GRS
- ST 7 planning during ST 7 part of science mode
 - Still options to discuss certain modes of operation
 - Include IFO, Drift mode
- A much larger participation in ST7/Pathfinder of NASA and the US community is essential to take full advantage of past investments

We are in danger of missing out on this opportunity!

Spent taxpayers money and ignore the results!

Ideally: Directed funding plus maybe some competed funding

Priorities

For the next few years for an ESA-led mission eLISA

1. The most likely contributions
 - a. Laser
 - b. Telescope
2. Potential contributions or demonstration of better hardware
 - a. Thrusters
 - b. Improved Electronic (mass, power)
 - c. Phasemeter
3. Maintaining/Building up Key Technology Testbeds
 - a. IMS
 - b. GRS
4. Risk Reduction items
 - a. Optical bench, etc. (Danger of losing expertise even in Europe)

Preliminary!!

Priorities

For the next few years for a US-led mission

Work in progress

Preliminary!!

A few comments/concerns:

One of the open questions is:

- Can we buy the GRS from Europe?
- Or is Europe providing it as a junior partner?

This dependency on Europe will increase if we focus now only on the most likely contributions ...

Examples

Laser:

- ESA formulated a goal of TRL5 laser by 2015
 - NASA laser systems are TRL 4-5
- 2W Power, RIN at $f > 2\text{MHz}$, Lifetime, ...

Telescope:

- In field guiding (scatter, ray tracing, prototype (does not need big telescope))
- Telescope design (\sim TRL 5 by 2015)
- Stability

uN-Thrusters (Colloidal, finish it)

- Lifetime (for 5+ years)

None of this requires multi million dollar investments over the next years!

But **continues** funding at a reasonable level

IMS and GRS Testbeds

- key technologies for eLISA type missions
 - challenges are the interactions and dependencies between parts
 - Develop/maintain understanding of these interactions
 - Training ground
 - Component testing ground (test as you fly!)
- Example: LIGO/GEO Prototypes (CalTech, Glasgow, Garching)

IMS Testbeds exist in US

- Maintain and improve at least one of the major ones

GRS Testbeds don't exist in US

- Should develop one closely following the European one
- Initial goal is not to develop a US GRS but if we have to, we better start developing experience

Again: None of this is a multi million dollar effort over the next years!

But again, it is also not for free!

Science/DA support

Justification:

- GW-SAG goals: Need to be able to analyze science capability of changing mission designs
 - Advances in Astrophysics, Data Analysis, Source Modeling allow us to do nearly all LISA Science with SGO/eLISA
 - Largest cost saving over the last years!
 - Enabling Technology
- Maintain and develop expertise
- Maintain research activity within evolving field of multi-messenger astronomy

Advocacy

- AAS
- HEAD
- APS
- Texas Meeting
- **LISA Symposium**
- LIGO/VIRGO Collaboration meetings??
- MG
- GR
- COSPAR

- Multi-messenger Astronomy ...